WHAT IS CLAIMED IS:

1. A method of sensing temperature at an optical fiber tip, comprising the following steps:

(a) positioning a slug of fluorescent material adjacent said optical fiber tip;

(b) providing an optical stimulus having a wavelength within a first predetermined range through at least one fiber optically linked to said optical fiber tip, wherein a desired optical fluorescent response having a wavelength within a second predetermined range from said fluorescent slug is generated;

(c) detecting a signal representative of said optical stimulus;

(d) detecting a signal representative of said optical fluorescent response;

(e) digitally processing said optical stimulus signal and said optical fluorescent response signal to determine a phase difference therebetween; and

(f) calculating a temperature for said optical fiber tip as a function of said phase difference.

2. The method of claim 1, wherein said fluorescent slug is comprised of a class of temperature dependent fluorescent materials including chromium-doped garnets, semiconductor-doped glasses, and phosphors.

3. The method of claim 1, wherein said optical stimulus signal and said optical fluorescent response signal are sinusoids having a predetermined frequency.

4. The method of claim 1, further comprising the step of calibrating said phase difference prior to said calculating step.

5. The method of claim 4, said calibrating step further comprising:

(a) detecting said optical stimulus directly to establish a normalized signal

thereof; and

(b) adjusting said detected optical stimulus signal according to said normalized
signal.

6. The method of claim 1, further comprising the step of filtering said optical
fluorescent response within said second predetermined wavelength range.

7. The method of claim 1, further comprising the step of maintaining said optical fiber
tip temperature within a specified range.

8. The method of claim 1, further comprising the step of comparing said optical
stimulus signal and said optical fluorescent response signal directly to determine the
phase difference therebetween.

9. The method of claim 1, further comprising the following steps:

(a) providing a reference signal;

(b) determining a first phase difference between said reference signal and said
optical stimulus signal;

(c) determining a second phase difference between said reference signal and
said optical fluorescent response signal; and

(d) determining the difference between said first phase difference and said
second phase difference.

10. A laser system, comprising:

(a) a laser for providing a laser beam having a wavelength within a first
predetermined range;

(b) at least one optical fiber having a first end in optical communication with
said laser beam and a second end through which said laser beam is
transmitted;

(c) a slug of fluorescent material positioned adjacent said second end of said optical fiber;

(d) a light source for providing an optical stimulus having a wavelength within a second predetermined range to said fluorescent slug, wherein a desired optical fluorescent response having a wavelength within a third predetermined range from said fluorescent slug is generated;

(e) a detector for detecting said optical fluorescent response;

(f) a device for receiving a first signal representative of said optical stimulus and a second signal representative of said optical fluorescent response; and

(g) a processor for determining a phase difference between said first and second signals, wherein the temperature of said optical fiber second end is determined as a function of said phase difference.

11. The laser system of claim 10, wherein said fluorescent slug is comprised of a class of temperature dependent fluorescent materials including chromium-doped garnets, semiconductor-doped glasses, and phosphors.

12. The laser system of claim 10, further comprising a device for providing a sinusoidal input to said light source, wherein said first and second signals have a corresponding sinusoidal form.

13. The laser system of claim 10, further comprising a device for filtering said optical fluorescent response within said third predetermined wavelength range.

14. The laser system of claim 10, wherein said processor controls a power output from said laser so as to maintain said temperature of said optical fiber second end within a specified range.

15. The laser system of claim 10, wherein said fluorescent slug is substantially transparent to light within said first predetermined wavelength range.

16. The laser system of claim 10, further comprising a port in a housing for said laser

system, wherein said light source is able to be in direct optical communication with said detector for calibration purposes.

17. An optical thermometry system, comprising:

    (a) an optical fiber having a first end for receiving light and a second end for transmitting said light;

    (b) a slug of fluorescent material positioned adjacent said optical fiber second end;

    (c) a light source for providing an optical stimulus through said optical fiber to said fluorescent slug in order to generate a desired optical fluorescent response therefrom;

    (d) a detector for detecting said optical fluorescent response; and

    (e) a device for receiving a first signal representative of said optical stimulus and a second signal representative of said optical fluorescent response; and,

    (f) a processor to determine a phase difference between said first and second signals.

18. The optical thermometry system of claim 17, wherein said optical stimulus signal and said optical fluorescent response signal is a sinusoid.

19. The optical thermometry system of claim 17, said device further providing a reference signal, wherein said phase difference between said optical stimulus signal and said optical fluorescent response signal is a function of a first phase difference between said reference signal and said optical stimulus signal and a second phase difference between said reference signal and said optical fluorescent response signal.

20. The optical thermometry system of claim 17, wherein said fluorescent slug is comprised of a class of temperature dependent luminescent materials including chromium-doped garnets, semiconductor-doped glasses, and phosphors.

21. The optical thermometry system of claim 17, further comprising a port in a housing for said system, wherein said light source is able to be in direct optical communication with said detector for calibration purposes.

22. A method of maintaining temperature of an optical fiber tip in a laser system at a desired temperature, comprising the following steps:

    (a) processing specified light signals to determine a temperature for said optical fiber tip as a function thereof;

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    (b) comparing said determined temperature for said optical fiber tip to said desired temperature;

    (c) generating an error signal as a function of any difference between said determined temperature and said desired temperature; and

    (d) controlling power output to a laserdiode of said laser system in accordance

10   with said error signal.

23. The method of claim 22, further comprising the step of determining whether said determined temperature is within a defined control band for said desired temperature having an upper limit and a lower limit.

24. The method of claim 23, wherein a maximum power output is provided to said laserdiode when said determined temperature is less than said lower limit for said control band.

25. The method of claim 23, wherein a minimum power output is provided to said laserdiode when said determined temperature is greater than said upper limit for said control band.

26. The method of claim 23, wherein said power output to said laserdiode is a function of a proportional component and an integrator component when said determined temperature is within said control band.

27. The method of claim 26, said proportional component of said power output being the product of said error signal and a proportional scaling factor.

28. The method of claim 26, said integrator component of said power output being the product of an integrator scaling factor and each said error signal integrated over time.

29. The method of claim 28, said integrator component being preloaded upon said determined temperature transitioning into said control band so that said power output to said laserdiode remains continuous during said transition.

30. A system for maintaining temperature of an optical fiber tip in a laser system at a desired temperature, said laser system including a laser diode for providing a laser beam to said optical fiber tip, comprising:

    (a) a processor for determining a temperature for said optical fiber tip as a function of specified light signals detected in said laser system;

    (b) a power amplifier for supplying power to said laser diode; and

    (c) a controller for providing a power output signal to said power amplifier, said controller containing an algorithm for calculating said power output signal which is a function of an error signal generated by a comparison of said determined temperature and said desired temperature.

31. The system of claim 30, wherein said controller provides a power output signal so that a maximum power is supplied to said laser diode by said power amplifier when said determined temperature is less than a lower limit of a defined control band for said desired temperature.

32. The system of claim 30, wherein said controller provides a power output signal so that a minimum power is supplied to said laser diode by said power amplifier when said determined temperature is greater than an upper limit of a defined control band for said desired temperature.

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33. The system of claim 30, wherein said algorithm is a function of a proportional component and an integrator component when said determined temperature is within a defined control band for said desired temperature.

34. The system of claim 33, said proportional component of said algorithm being a product of said error signal and a proportional scaling factor.

35. The system of claim 33, said integrator component of said algorithm being a product of an integrator scaling factor and each said error signal integrated over time.

36. The system of claim 35, said integrator component being preloaded upon said determined temperature transitioning into said control band so that power supplied to said laser diode remains continuous during said transition.